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Self-reported stress and psychophysiological reactivity in paramedics

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ABSTRACT

Background: As an important group of health care professionals, paramedics accomplish sophisticated and frequently stressful tasks.

Design: The study investigated self-reported stress burden, self-reported health status, coping strategies, personality traits and psychophysiological reactivity in paramedics.

Methods: 30 paramedics were compared with 30 professionals from other disciplines, in terms of self-reported stress, physical complaints, coping strategies, personality traits and psychophysiological reactivity during aversive visual and acoustic stimuli, and cognitive challenge. Regression analyses were performed for the prediction of stress burden and physical complaints in paramedics according to coping and personality factors.

Results: Paramedics reported lower stress and less somatic complaints, and exhibited reduced electrodermal activity and heart rate responses to experimental stimuli, as well as higher respiratory sinus arrhythmia. They indicated less negative coping strategies, reduced empathy, and higher conscientiousness and sensation seeking. Higher self-reported stress burden and more physical symptoms were associated inter alia with more negative coping strategies, less conscientiousness and lower empathy.

Conclusion: The findings support the notion of reduced self-reported stress burden, and improved general health and stress resistance in paramedics. In addition to health benefits, stress tolerance may contribute to the prevention of performance decline during situations in which health and life are at stake.

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Paramedics; stress; coping; electrodermal activity; respiratory sinus arrhythmia

As an important group of health care professionals, paramedics apply first aid, care for sick or injured individuals and assist doctors in emergency situations. Beside routine tasks like driving ambulances and documenting operations, paramedics are frequently confronted with difficult and risky situations, such as severe accidents or life-threatening acute diseases, which require rapid decision-making and action under complex conditions (Regehr, LeBlanc, Jelley, & Barath, 2008). Beside shiftwork and rapid switching between periods of rest and activity, unclear emergency calls can be seen as further stressors. Therefore, in addition to being well-trained, paramedics should exhibit definite abilities to deal with stress, in order to treat patients optimal and ensure their own health and wellbeing (Gayton & Lovell, 2012).

The present study aimed to investigate self-reported stress burden and psychophysiological reactivity in paramedics and a control group drawn from other professional fields, in addition to self-reported health status, coping strategies and personality traits. Although emergency service provision must undoubtedly be regarded as highly demanding work, it is not certain that paramedics

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experience greater work-related stress than other professional groups or the general population (Gayton & Lovell, 2012). Interestingly, some studies even reported lower stress burden, as well as better mental and physical health, in first responders compared to other professional groups (e.g., Kashdan & Rottenberg, 2010). In this regard, paramedics reported, for example, mainly focusing on the cognitive and technical aspects of their tasks instead of human tragedies, indicating efficient handling of these challenges (Kashdan & Rottenberg, 2010; Regehr, Goldberg, & Hughes, 2002). To date, few studies have investigated personality traits in paramedics and their relevance to work-related stress; paramedics scored lower on the personality dimensions of neuroticism, openness and agreeableness, and higher on conscientiousness, with respect to samples drawn from the general population, possibly indicating that paramedics benefit from a calm, thoughtful and thorough manner (e.g., Mirhaghi, Mirhaghi, Oshio, & Sarabian, 2016). In addition, sensation seeking has been identified as a common trait among paramedics (Chng & Eaddy, 1999; Klee & Renner, 2013). Sensation seeking refers to the tendency to place oneself in risky situations and seek out extreme experiences, intense feelings and states of high arousal (Zuckerman, 2010). The association between emergency service-based work and exposure to intense and arousing situations may motivate high sensation seeking individuals to choose this profession (Mirhaghi et al., 2016).

In addition, psychophysiological reactivity was quantified in our study. Stimulation conditions comprised visual and acoustic affective stimuli, which resembled typical burdensome situations related to the provision of emergency services, in addition to non-specific emotional stimuli. Furthermore, arithmetic and visuospatial tasks were presented in order to generate cognitive load. Electrodermal activity (EDA) and heart rate were included as response parameters reflecting autonomic nervous system activity (Dawson, Schell, & Filion, 2007). In addition, the high frequency band of the heart rate variability (HRV) spectrum (i.e., respiratory sinus arrhythmia, RSA) was obtained. RSA is a well-established index of parasympathetic influences on heart rate, where acute and chronic stress are accompanied by HRV reduction (Berntson, Quigley, Norman, & Lozano, 2016). Higher levels of HRV are associated with a lower risk for the development of mental and physical diseases (Thayer & Lane, 2009). Psychophysiological research in paramedics remains scarce. While elevated heart rate was observed during emergency missions, indicating increased physiological arousal (Karlsson, Niemelä, & Jonsson, 2011), ambulance service personnel did not differ from the general population in terms of cardiovascular fitness (Gamble et al., 1991). Furthermore, a sample of crisis managers, i.e. executive personal directing large-scale emergency operations, exhibited lower EDA and heart rate modulations during aversive emotional stimulation and cognitive load than managers from other disciplines, in addition to reduced subjective stress (Janka et al., 2015). This was interpreted as being indicative of improved stress-resistance, i.e. psychophysiological adjustment following repeated exposure to challenging emergency situations.

As a secondary aim, the study investigated associations of coping strategies and personality traits with self-reported stress burden and health status in paramedics. The dependence of stress burden and its health impacts on an individual's method of dealing with stress has been well-established (Penley, Tomaka, & Wiebe, 2002). It has been shown in paramedics that coping strategies including situation and reaction control are associated with lower stress burden, while tendencies such as rumination and resignation are accompanied by elevated stress (Avraham, Goldblatt, & Yafe, 2014; Prati, Pietrantoni, & Cicognani, 2011). Moreover, active coping while maintaining emotional distance from the patient was related to lower perceived stress in paramedics (Regehr et al., 2002); as such, excessive empathy may be associated with higher stress levels and more health complaints (Grevin, 1996). Regarding personality traits, it has been reported in paramedics that extraversion, agreeableness and conscientiousness are inversely related to perceived stress, indicating higher stress resistance in those who are more open, responsible and tolerant (Mirhaghi & Sarabian, 2016). Furthermore, healthy individuals who scored higher on the thrill and adventure seeking dimensions of sensation seeking reported less physical and psychological complaints, which was interpreted as indicative of protective effects of sensation seeking against stress burden (De Brabander, Hellemans, Boone, & Gerits, 1996).

In summary, the following hypotheses were tested in this study: (1) Paramedics report lower stress burden and less physical complaints than control persons from other disciplines. (2) Paramedics indicate using more positive and less negative coping strategies than controls. (3) They also score higher in conscientiousness and sensation seeking, and lower in empathy and neuroticism. (4) Moreover, in paramedics, negative coping strategies are associated with higher perceived stress burden and more physical complaints. (5) In contrast, positive coping strategies, conscientiousness, empathy and sensation seeking are associated with less perceived stress burden and improved physical health.

Methods

Participants

In total, 30 Austrian paramedics (25 men, 5 women) participated in the study. All of the paramedics had completed emergency medical assistant training, i.e. specific training pertaining to the provision of basic life support in emergency situations. This implies self-reliant care for sick or injured persons, who require medically indicated support before and during transport, including blood infusions or extractions for the purpose of emergency diagnostics. Further duties include assisting during acute emergency situations, for example by providing oxygen, and applying life-saving techniques, such as retrieval and maintenance of vital body functions, and defibrillation using semi-automatic devices. The paramedics included in this study had been engaged in such activities for at least 5 years and were on duty for a minimum of 520 hours per year. There were 17 (56.7%) full-time and 13 (43.3%) voluntary workers.

The control group comprised 30 individuals (24 men, 6 women) who did not work in the rescue services field. Of the controls, 10 (33.3%) were employees (e.g., clerical workers in advertising, logistic and government agencies), 8 (26.7%) worked in the educational sector (e.g., school teacher, driving teacher, teacher for children with special needs), 2 (6.7%) worked in craft services (e.g., builder, mechanic, butcher), 6 (20.0%) were university students and 4 (13.3%) were university research assistants.

Exclusion criteria for both study groups were any kind of physical disease or mental disorder, as well as the use of drugs affecting the central nervous or cardiovascular system. The two groups were similar in age (paramedics: $M = 33.68$ years, SD = 9.55; control group: $M = 33.48$ years, SD = 11.67; $F[1,58] = 0.01$, $p = .95$, $\eta_p^2 < .01$) and total work experience (paramedics: $M = 15.60$ years, SD = 11.07; control group: $M = 11.95$ years, SD = 12.20; $F[1,58] = 1.47$, $p = .23$, $\eta_p^2 = .03$). Moreover, they did not differ in body mass index (paramedics: $M = 25.44$ kg/m^2, SD = 4.44; control group: $M = 23.83$ kg/m^2, SD = 3.14; $F[1,58] = 2.50$, $p = .12$, $\eta_p^2 = .04$), physical activity (paramedics: $M = 4.96$ hours/week, SD = 4.07; control group: $M = 3.55$ hours/week, SD = 3.30; $F[1,58] = 2.08$, $p = .16$, $\eta_p^2 = .01$), nicotine consumption (paramedics: $M = 0.80$ cigarettes/day, SD = 2.22; control group: $M = 1.48$ cigarettes/day, SD = 4.65; $F[1,58] = 0.52$, $p = .48$, $\eta_p^2 = .01$) or alcohol consumption (paramedics: $M = 0.32$ days/week, SD = 0.91; control group: $M = 0.83$ days/week, SD = 1.17; $F[1,58] = 3.33$, $p = .07$, $\eta_p^2 = .06$). All participants signed a written informed consent form prior to the study, which was approved by the Research Committee for Scientific and Ethical Questions of UMIT – University of Health Sciences Medical Informatics and Technology.

Questionnaires

Self-reported stress

To assess current self-perceived stress level, the German version of the Perceived Stress Questionnaire was applied (PSQ, Fliege et al., 2005; Levenstein et al., 1993). The instrument comprises four scales, with five items per scale. Alpha values of the subscales range between .80 and .86 (Fliege et al., 2005). The Worries scale quantifies worries and anxiety regarding the future, as well as feelings of desperation and frustration; the Tension scale is concerned with agitation, fatigue and the inability to relax; the Joy scale indexes positive feelings, of joy, energy and security; and the Demands scale relates to perceived environmental stressors, such as time pressures and work overload. A sum score can also be computed over all four scales. Joy scale items are inversely coded, such that higher values on all scales reflect increased stress. Fliege et al. (2005) provided normative values of a healthy adult group (N = 334), which allowed comparison with the presently investigated groups. Means of the normative sample were as follows: Worries, 26 (SD = 20); Tension, 34 (SD = 21); Joy, 38 (SD = 21); Demands, 36 (SD = 21); sum score, 33 (SD = 17).

Self-reported somatic complaints

The von Zerssen Symptom Checklist [Beschwerden-Liste, BL-R] (von Zerssen & Petermann, 2011) was used to assess self-experienced burden caused by somatic complaints. The 20 items of the BL-R include statements on frequent general symptoms (e.g., fatigue, tiredness), as well as more specific complaints (e.g., chest pain, nausea, insomnia). A sum score is computed over all items, where high values represent greater symptom burden. Alpha value for the sum score is .94 (von Zerssen & Petermann, 2011).

Personality traits

The German version of the Big Five Inventory (BFI-44; John, Donahue, & Kentle, 1991; Lang, Lüdtke, & Asendorpf, 2001) was applied to assess personality traits. The questionnaire consists of the following scales (with 44 items each): the Extraversion scale comprises attributes such as sociability, assertiveness, and positive emotions; the Agreeableness scale includes characteristics such as trust, altruism and compliance; the Conscientiousness scale covers competence, orderliness, self-discipline and deliberation; the Neuroticism scale includes characteristics such as anxiety, hostility, depression, impulsiveness and vulnerability; and the Openness scale indexes characteristics such as curiosity, ingenuity and unconventionality. High scores indicate higher levels of the different traits. Alpha values for the subscales range between .67 and .82 (Lang et al., 2001).

Coping with stress

The 78-item version of the Stress Coping Questionnaire [Stressverarbeitungsfragebogen, SVF-78] (Erdmann & Janke, 2008) was used to assess strategies for coping with stressful events. This questionnaire includes the following 13 scales: (1) Self-aggrandizement in comparison with others, (2) Denial of guilt, (3) Distraction, (4) Substitute gratification, (5) Situation control, (6) Reaction control, (7) Positive self-instruction, (8) Need for social support, (9) Avoidance, (10) Escape, (11) Rumination, (12) Resignation, and (13) Self-blame. Scales 1 to 8 can be aggregated into a sum scale of positive coping strategies that tend to reduce stress and scales 9 to 13 can be combined to produce a sum scale of negative coping strategies that potentially increase stress (Balcar, Trnka, & Kuska, 2011; Weyers, Ising, Reuter, & Janke, 2005). Alpha values of the subscales range between .62 and .96 (Erdmann & Janke, 2008).

Empathy

The Saarbruecken Personality Questionnaire on Empathy [Saarbrücker Persönlichkeitsfragebogen zur Messung von Empathie, SPF] (Paulus, 2009) was presented to determine aspects of empathy. The instrument includes 16 items over four scales: whereas the Perspective-taking scale represents the cognitive dimension of empathy, the Fantasy, Empathetic concern and Personal distress scales relate to the emotional dimension. A sum score can also be calculated, where higher values denote higher levels of empathy. Alpha values for the subscales range between .66 and .74 (Paulus, 2009).

Sensation seeking

Sensation seeking was quantified using the Sensation Seeking Scale Form V (SSS-V, Zuckerman, Eysenck, & Eysenck, 1978). This questionnaire is comprised of four scales (10 items each): the Boredom susceptibility scale indexes the need for constant, novel external stimulation and aversion to boring or repetitive activities; the Disinhibition scale refers to disinhibited social behavior expressed by partying, alcohol and sex; the Experience seeking scale measures the propensity to pursue an unconventional life style (characterized by unplanned activities and/or drug-taking); and the Adventure seeking scale evaluates the pursuit of risky and exciting sport activities. In addition, a sum score can be computed, where higher values correspond to higher levels of sensation seeking. Alpha value for the sum score is .82 (Beauducel, Strobel, & Brocke, 2003).

Alpha values for all applied questionnaire scales computed in the present sample are provided as Supplementary Material.

Induction of negative affect and cognitive load

Negative affect was induced via the following stimulation conditions: a visual affective condition comprised 45 images taken from the International Affective Picture System (Lang, Bradley, & Cuthbert, 1997) and classified into three categories (15 images per category): the first category included negative affective images of situations specifically related to emergency service work (e.g., injuries); the second category comprised non-specific aversive images (e.g., shark); and the third category featured pleasant images (e.g., positive social situations). The pleasant images served as a control condition, allowing investigation of a possible group difference in general emotional responsiveness. Images were presented on the screen for 5 s each in a pseudorandom order, with interstimulus intervals of 5, 8 and 10 s. Average normative ratings of the images on the arousal and valence dimensions were as follows (Lang et al., 1997): emergency service-related affective images, arousal: $M = 6.24$ (SD = 0.64), valence: $M = 7.08$ (SD = 0.35); non-specific aversive images, arousal: $M = 6.49$ (SD = 0.41), valence: $M = 6.39$ (SD = 0.65); and pleasant images, arousal: $M = 6.17$ (SD = 0.83), valence: $M = 1.81$ (SD = 0.56). Higher values denote higher levels arousal and negative valence.

Two acoustic stimuli were applied as additional negative emotional conditions. The first of these stimuli comprised a series of noises specifically related to emergency service work: particular sounds (e.g., screaming people, the landing of a helicopter) were selected from the International Affective Digitized Sound system (Bradley & Lang, 2007a). Their average normative ratings were as follows: $M = 6.48$ (SD = 1.17) for arousal, and $M = 3.59$ (SD = 1.97) for valence. As a non-specific acoustic aversive stimulus, a sample of self-programmed, non-melodic synthesizer music was used. Both acoustic stimuli were presented for 1 min via earphones with a sound pressure level between 59 and 63 dB. Each stimulus was both preceded and followed by a 1-min rest period (baseline and recovery, respectively).

A mental arithmetic task was used to evoke cognitive load (Kirschbaum, Pirke, & Hellhammer, 1993). During this task, participants were instructed to count backwards in steps of 13, beginning with 1,022. If a mistake was made, a loud bell rang and participants had to restart from the beginning. A mirror drawing task was applied as an additional condition of cognitive challenge (Homma, 2005). For this purpose, a wooden box, with a mirror attached to its back, was placed in front of the participant. The participant had to trace a route through a labyrinth, visible (mirror-inverted) in the mirror, on a sheet of paper at the bottom of the box without drawing outside of the edges. Participants were instructed to perform the task as quickly and as precisely as possible. If a mistake was made, the experimenter rang a loud bell and the participant had to restart the task. The duration of both cognitive tasks was 2 min, and each task was preceded and followed by a 1 min resting period (baseline and recovery, respectively).

Participants had to rate all stimulation conditions according to affective arousal and valence on Self-Assessment Manikin (SAM) scales (Lang et al., 1997). For this purpose, images were presented again in the same order after the initial phase. Regarding the noises and cognitive tasks, SAM scales were completed immediately after the recovery period following the corresponding stimulation phase. During the entire experimental period participants sat in front of a 19 inch monitor at a distance of approximately 1 m. Between stimuli, a white cross appeared in the middle of the screen, signaling to the participants that they were to sit still and refrain from speaking. Images and noises were presented with the software package Presentation (ver. 17.1; Neurobehavioral Systems, USA).

Psychophysiological recordings

EDA and heart rate were recorded using a Biopac amplifier (MP 150, Biopac Systems Inc., Goleta, CA, USA). Two Ag/AgCl finger electrodes with a diameter of 6 mm were placed at the third and fourth finger of the non-dominant hand for EDA recording. EDA electrodes were attached approximately 10 min before the beginning of the recording procedure using Gel 101 (Biopac Systems Inc.) electrode paste. Heart rate was obtained using ECG, which was recorded from two electrodes placed at the right mid-clavicle and lowest left rib. Data were recorded at a sampling rate of 1,000 Hz. Prior to the executions of the affective and cognitive paradigms, EDA and ECG recordings were accomplished with participants at rest for 7 min. For this purpose, the participants were asked to relax and fixate upon a white cross on the screen. Subjects were requested not to drink alcohol or beverages containing caffeine for at least 2 h prior to the experimental session.

Data analysis

For analyzing the EDA data, an event-related analysis tool of the Acqknowledge software (Biopac Systems Inc., Goleta, CA, USA) was used. This routine identifies changes in EDA, which are related to specific events. In the analysis of the ECG, heart cycle duration values, defined as the inter-beat-interval (RR), were computed using Kardia software (Perakakis, Joffily, Taylor, Guerra, & Vila, 2010). The ECG data were visually screened, and artifacts were corrected by linear interpolation. Subsequently, the beat-to-beat values were transformed to time-based data with a sample rate of 2 Hz.

In order to assess psychophysiological responses to the presented stimuli, absolute changes from baseline were computed for EDA and heart rate. Baseline was set to 2 s for all stimuli. Concerning the visual stimuli, the data were averaged across the 15 images of each category. Maximum changes were determined in specific response intervals, defined according to visual inspection of the data. For the images, this time window comprised the first 8 s after stimulus onset. Responses to acoustic stimuli were determined within a time window of 20 s; the time window for both cognitive stimuli was set to 30 s.

RSA was quantified by means of spectral analysis. For this purpose, RR intervals were extracted from ECG by an *R* peak detection algorithm using Kardia software (Perakakis et al., 2010). The recordings were visually screened and artifacts were corrected prior to computation of the time series of RR intervals. Missing *R* waves were interpolated from surrounding beats. RSA was derived from the series of RR intervals by means of Fast-Fourier-Transformation (extraction through a Hamming window) using Kubios HRV software (version 2) (Tarvainen & Niskanen, 2012). RSA was indexed by spectral power density in the frequency range 0.15–0.40 Hz (Berntson et al., 2016). Due to violation of the normality assumption, all RSA scores were log-transformed (natural logarithm) prior to statistical analysis. To enable control of possible effects of respiration in the group comparison regarding RSA (Berntson et al., 2016), respiratory frequency was estimated during Fast Fourier transformation of RR intervals, and indexed as individual peak frequency of the high frequency band. RSA data were obtained for the 7 min resting period at the beginning of the experimental session (see section Psychophysiological Recordings). Moreover, RSA was assessed during exposure to acoustic and cognitive stimulation conditions. In order to evaluate stimulus-related changes, recording periods also included 1 min resting phases preceding and following stimulus exposure (baseline and recovery, respectively). RSA was not assessed during visual stimuli, because their duration (5 s) was too short for reliable quantification.

For statistical analysis of the data obtained during affective and cognitive stimulation, ANOVA models were computed with study group (paramedics vs. control group) as the between-subjects factor and the conditions of the respective paradigms as within-subjects factors; these were the image condition (emergency-related, non-specific aversive, pleasant) for the visual stimuli, the noise condition (emergency service-related, non-specific) for the acoustic stimuli and the task condition (mental arithmetic task, mirror drawing task) for cognitive challenge. Separate models were computed with the SAM ratings and EDA and heart rate amplitudes as dependent variables. For the analysis of RSA during the acoustic and cognitive stimulation conditions, two three-way ANOVAs were conducted with study group as a between-subjects factor and task condition (emergency service-related noises, non-specific noises; mental arithmetic task, mirror drawing task) and experimental period (baseline, stimulus exposure, recovery) as within-subjects factors. To control for the effects of respiration, in a first step linear regression models were computed for resting RSA and all periods of the acoustic and cognitive paradigms, with respiratory frequency as a predictor and log RSA as the dependent variable. Unstandardized residuals – which are independent of respiratory frequency – resulting from the regression equations were computed (Cohen, Cohen, West, & Aiken, 2003). The ANOVA models were conducted with the residuals as dependent variables.

Demographic and questionnaire data, as well as RSA during the 7-min resting period, were compared between groups using one-way ANOVAs. To account for possible α-inflation, a Bonferroni–Holm procedure was applied to the questionnaire data. All p-values per questionnaire (k) were ordered from smallest to largest. Then, the lowest p-value was selected and compared to α/k ($\alpha = .05$). If this first p-value was significant, the second p-value was compared to $\alpha/(k-1)$. This process was repeated until the selected p-value did not fall below the corresponding adjusted α-level (Holm, 1979). Consequently, an adjusted α -level of .01 (.05/5) was used for the PSQ, BFI-44, SPF and SSS-V. For the SVF-78, an adjusted alpha-level of .0036 (.05/14) was applied.

Additionally, Stepwise regression analyses were computed with the sum scores of the PSQ and the BL-R as dependent variables and the scales of the remaining questionnaires as predictors. Separate analyses were accomplished for each of the questionnaires (i.e., SVF-78, BFI-44, SPF and SSS-V). To avoid collinearity, and following the recommendation of a maximal number of predictors of N/10 (Hair, Black, Babin, & Anderson, 2010), no more than three predictors were used in each of the analyses. The sets of predictors were determined via correlation analysis; only those scales were used as predictors, which showed significant Pearson correlations with the criteria (i.e., PSQ and BL-R sum scores). In addition, due to the similar contents of the scales, the SPF Personal distress scale was excluded from the regression analysis concerning the PSQ. The following scales were applied as predictors of the PSQ sum score: Positive strategies sum scale (SVF-78) ($r = -.37$, $p = .04$), Negative strategies sum scale (SVF-78) ($r = .37$, $p = .04$), Extraversion (BFI-44) ($r = -.49$, $p = .01$), Agreeableness (BFI-44) ($r = -.40$, $p = .03$), Conscientiousness (BFI-44) ($r = -.56$, $p = < .01$), Empathic concern (SPF) ($r = -.38$, $p = .04$) and Adventure seeking (SSS-V) ($r = .43$, $p = .02$). The following scales were used as predictors of the BL-R: Worries (PSQ) ($r = .57$, $p < .01$), Negative strategies sum scale (SVF-78) ($r = .47$, $p = .01$), Conscientiousness (BFI-44) ($r = -.41$, $p = .02$), Neuroticism (BFI-44) ($r = .41$, $p = .03$) Fantasy (SSS-V) ($r = .53$, $p = < .01$) and Personal Distress (SSS-V) ($r = .42$, $p = .02$).

Results

Results concerning the questionnaire scales are presented in Table 1. According to Bonferroni Holmes corrected testing, paramedics exhibited lower scores on the PSQ scales of Worries, Tension and Joy, as well as sum score, than controls. The values of the controls were similar to the norm values (c.f. Questionnaires section). However, the sum score of the paramedic group fell approximately one SD below the norm value; the Worries, Tension, Joy and Demands scores were also markedly lower than the corresponding norm values. Paramedics furthermore scored lower than controls on the BL-R. Regarding the SVF-78, paramedics revealed lower scores on the Rumination and Resignation scales, as well as on the negative coping strategies sum scale. Paramedics exhibited higher scores on the Conscientiousness scale of the BFI-44. They furthermore scored lower on the Empathetic concern, and Personal distress scales, as well as on the sum scale, of the SPF. Finally, they showed higher values on the Experience seeking scale of the SSS-

Table 1. Questionnaire scale scores in both study groups; statistics of the group comparison.

	Paramedics *M* (SD)	Control group *M* (SD)	*F*[1,58]	*p*	η_p^2
Perceived Stress Questionnaire (PSQ)					
Worries	9.33 (10.59)	24.44 (13.14)	24.05	< .01	.30
Tension	16.00 (13.05)	29.78 (14.09)	15.44	< .01	.21
Joy	18.89 (15.07)	33.33 (18.53)	10.97	< .01	.16
Demands	29.78 (14.30)	37.78 (16.27)	4.09	.04	.07
Sum score	18.50 (11.22)	31.33 (10.16)	21.57	< .01	.27
Von Zerssen symptom checklist (BL-R)					
Sum score	26.90 (5.73)	32.63 (7.97)	10.23	< .01	.15
Stress Coping Style Questionnaire (SVF-78)					
Self-aggrandizement by comparison with others	18.27 (4.84)	17.14 (4.36)	0.98	.33	.02
Denial of guilt	17.00 (3.66)	16.52 (3.80)	0.31	.58	.01
Distraction	17.17 (3.43)	17.66 (4.20)	0.25	.62	< .01
Substitute gratification	15.07 (3.89)	14.86 (4.78)	0.04	.84	< .01
Situation control	21.03 (3.12)	22.28 (3.35)	2.20	.14	.04
Reaction control	20.53 (3.76)	20.03 (3.99)	0.25	.62	< .01
Positive self-instruction	23.07 (3.93)	22.24 (3.93)	0.64	.43	.01
Need for social support	19.67 (3.95)	20.86 (4.84)	1.09	.30	.02
Avoidance	16.60 (4.69)	17.07 (3.89)	0.17	.68	< .01
Escape	11.40 (3.67)	12.69 (3.31)	2.01	.16	.03
Rumination	14.73 (3.96)	21.03 (4.47)	33.31	< .01	.37
Resignation	10.37 (3.24)	13.17 (3.34)	10.93	< .01	.16
Self-blame	14.17 (4.31)	16.36 (3.73)	4.51	.04	.07
Positive strategies sum scale	18.88 (2.47)	18.67 (2.32)	0.12	.73	< .01
Negative strategies sum scale	12.67 (3.07)	15.82 (2.72)	17.61	< .01	.23
Big Five Inventory 44 (BFI-44)					
Extraversion	29.50 (4.82)	28.60 (4.76)	0.53	.47	.01
Agreeableness	34.17 (5.66)	33.40 (3.34)	0.41	.53	.01
Conscientiousness	36.90 (4.94)	32.23 (2.20)	11.95	< .01	.17
Neuroticism	21.00 (2.53)	22.53 (2.19)	6.28	.02	.10
Openness	34.23 (5.21)	35.87 (6.93)	1.06	.31	.02
Saarbrueck Personality Questionnaire on Empathy (SPF)					
Perspective taking	3.50 (0.53)	3.58 (0.64)	0.25	.62	< .01
Fantasy	2.61 (0.97)	3.14 (0.81)	5.33	.03	.08
Empathic concern	3.27 (0.54)	3.67 (0.59)	7.72	.01	.12
Personal distress	1.81 (0.47)	2.59 (0.74)	24.52	< .01	.30
Sum score	3.13 (0.51)	3.47 (0.53)	6.47	.01	.10
Sensation Seeking Scale (SSS-V)					
Adventure seeking	13.70 (2.61)	13.33 (2.52)	0.31	.58	< .01
Disinhibition	16.73 (2.30)	15.50 (2.26)	4.39	.04	.07
Experience seeking	15.27 (1.60)	13.97 (1.54)	10.29	< .01	.15
Boredom susceptibility	17.00 (1.55)	16.47 (1.85)	1.46	.23	.03
Sum score	62.70 (5.33)	59.27 (5.53)	6.00	.02	.09

Note: *M* = mean; SD = standard deviation.

V. While alpha values of most of the questionnaire scale were in the satisfactory range (.65 to .92), low values arouse for the Boredom susceptibility (.35) and Experience seeking (.45) scales from the SSS-V (c.f. Supplementary Material).

Table 2 delineates the SAM ratings regarding the paradigms pertaining to negative affect and cognitive load and EDA and heart rate response amplitudes, defined as the maximal absolute changes from baseline during stimulus exposure, together with the statistics of group effects in the ANOVAs. Group effects for the SAM ratings of visual and acoustic stimuli indicate lower self-reported arousal and less negative valence of paramedics than controls. In addition, lower EDA amplitudes during visual, acoustic and cognitive stimuli and lower heart rate amplitudes during visual stimuli, were found in paramedics. No interactions between group and condition arose in any of these models (all $F \leq 3.15$, all $p \geq .08$, all $\eta_p^2 \leq .05$). The time courses of EDA and heart rate during stimulus exposure are displayed in the Supplementary Material (Figures 1 and 4). While EDA increased during presentation of all stimuli, heart rate transiently decelerated during the visual stimuli.

Table 2. SAM scale scores, EDA and heart rate response amplitudes; statistics of the group effect.

	Paramedics *M* (SD)	Control group *M* (SD)	*F*[1,58]	*p*	η_p^2
SAM scale valence					
Images					
Emergency service-related	6.04 (1.66)	7.56 (0.72)			
Non-specific aversive	6.17 (1.65)	6.53 (0.81)	15.35	< .01	.21
Pleasant	2.48 (1.01)	2.47 (0.72)			
Noises					
Emergency service-related	6.03 (1.88)	7.90 (1.03)	11.80	< .01	.17
Non-specific	5.17 (2.04)	6.37 (1.92)			
Cognitive tasks					
Mental arithmetic task	6.90 (2.22)	6.30 (1.39)	1.46	.23	.03
Mirror drawing task	6.53 (2.71)	5.67 (2.32)			
SAM scale arousal					
Images					
Emergency service-related	3.88 (1.41)	5.90 (1.50)			
Non-specific aversive	4.39 (1.56)	4.95 (1.47)	6.32	.02	.10
Pleasant	3.17 (1.50)	4.16 (1.67)			
Noises					
Emergency service-related	5.60 (1.98)	7.17 (1.76)	17.76	< .01	.23
Non-specific	3.87 (2.01)	5.17 (2.05)			
Cognitive tasks					
Mental arithmetic task	3.43 (2.62)	4.60 (3.07)	1.76	.19	.03
Mirror drawing task	3.90 (2.28)	3.97 (2.95)			
EDA response (µS)					
Images					
Emergency service-related	0.0657 (0.0658)	0.1144 (0.1090)			
Non-specific aversive	0.0718 (0.0713)	0.1201 (0.1033)	5.27	.03	.08
Pleasant	0.0530 (0.0577)	0.0975 (0.0891)			
Noises					
Emergency service-related	0.6573 (0.5444)	0.9982 (0.6833)	5.17	.03	.08
Non-specific	0.4842 (0.4510)	0.7598 (0.5043)			
Cognitive tasks					
Mental arithmetic task	0.2661 (0.2510)	0.6135 (0.2952)	19.30	< .01	.25
Mirror drawing task	0.3231 (0.2592)	0.5641 (0.3243)			
Heart rate response (beats/min)					
Images					
Emergency service-related	−0.2269 (0.3539)	−0.4782 (0.4181)			
Non-specific aversive	−0.1495 (0.2323)	−0.2969 (0.3368)	6.72	.01	.10
Pleasant	−0.2599 (0.3604)	−0.3705 (0.2438)			
Noises					
Emergency service-related	4.1324 (2.5116)	3.8662 (2.0194)	0.55	.46	.01
Non-specific	4.0022 (1.9626)	3.7931 (1.6473)			
Cognitive tasks					
Mental arithmetic task	4.2662 (2.3470)	4.2778 (2.6870)	0.07	.80	< .01
Mirror drawing task	4.2915 (2.2206)	4.5662 (2.3898)			

Note: *M* = mean; SD = standard deviation; SAM = Self-Assessment Manikin; EDA = electrodermal activity; response amplitudes refer to the maximal absolute signal change from baseline during stimuli exposure; in SAM scale scores higher values denote higher arousal and more negative valence.

RSA recorded during the 7 min resting period prior to testing was higher in paramedics ($M = 6.48$ log (ms^2), SD = 1.14 log (ms^2)) than controls ($M = 5.45$ log (ms^2), SD = 1.62 log (ms^2)) ($F[1,58] = 8.05$, $p = .01$, $\eta_p^2 = .12$). Table 3 presents values of RSA and respiratory frequency during the paradigms of acoustic and cognitive stimulation. The ANOVA for the acoustic stimuli revealed a group effect, with higher values being seen in paramedics ($F[1,58] = 7.88$, $p = .01$, $\eta_p^2 = .12$). No group effect arose in the model for the cognitive tasks ($F[1,58] = 1.26$, $p = .27$, $\eta_p^2 = .02$). The effects of the experimental periods did not reach significance (acoustic stimuli: $F[5,290] = 2.39$, $p = .06$, $\eta_p^2 = .04$; cognitive tasks: $F[5,290] = 1.55$, $p = .18$, $\eta_p^2 = .03$). No interactions between group and experimental periods arose (acoustic stimuli: $F[5,290] = 0.55$, $p = .68$, $\eta_p^2 = .01$; cognitive tasks: $F[5,290] = 0.79$, $p = .56$, $\eta_p^2 = .01$).

Results of regression analyses for the prediction of the PSQ and BL-R sum scores are summarized in Table 4. The PSQ sum score was positively predicted by the Adventure seeking scale of the SSS-V

Table 3. RSA (log (ms^2)) and respiratory rate (cycles/minute) during acoustic stimuli and cognitive tasks (baseline, stimulus/task exposure, and recovery).

RSA (log (ms^2))	Paramedics *M* (SD)	Control group *M* (SD)
Emergency service-related noises		
Baseline	6.62 (1.33)	5.63 (1.51)
Stimulus exposure	6.67 (0.96)	5.59 (1.60)
Recovery	6.58 (1.11)	5.54 (2.07)
Non-specific noises		
Baseline	6.21 (1.17)	5.47 (1.80)
Stimulus exposure	6.36 (1.26)	5.31 (1.68)
Recovery	6.27 (1.27)	5.34 (1.99)
Mental arithmetic task		
Baseline	5.83 (1.47)	5.37 (1.49)
Task execution	5.97 (1.33)	5.26 (1.79)
Recovery	5.99 (1.35)	5.64 (1.27)
Mirror drawing task		
Baseline	5.81 (1.26)	5.70 (1.74)
Task execution	5.94 (1.56)	5.49 (1.42)
Recovery	6.09 (1.57)	5.88 (1.80)
Respiratory rate (cycles/minute)		
Emergency service-related noises		
Baseline	11.22 (2.31)	11.53 (3.27)
Stimulus exposure	10.10 (2.56)	11.11 (2.35)
Recovery	11.06 (2.78)	10.92 (2.70)
Non-specific noises		
Baseline	12.10 (3.32)	11.73 (3.67)
Stimulus exposure	12.26 (3.34)	10.87 (2.71)
Recovery	11.63 (2.97)	11.73 (3.37)
Mental arithmetic task		
Baseline	11.67 (3.73)	10.04 (1.55)
Task execution	10.32 (1.04)	10.53 (1.22)
Recovery	10.47 (3.02)	10.00 (1.54)
Mirror drawing task		
Baseline	10.40 (2.42)	10.41 (2.80)
Task execution	12.28 (4.01)	11.77 (3.40)
Recovery	10.87 (2.59)	11.27 (2.81)

Note: RSA = respiratory sinus arrhythmia; *M* = mean; SD = standard deviation.

and the Negative strategies sum scale of the SVF-78. Moreover, the Conscientiousness scale of the BFI-44, the Positive strategies sum scale of the SVF-78 and the Empathetic concern scale of the SPF were negative predictors. In the models concerning the BL-R, the Worries scale of the PSQ, Negative strategies sum score of the SVF-78, and the Fantasy and Personal distress scales of the SPF were positive predictors. The Conscientiousness scale of the BFI-44 was a negative predictor. The obtained collinearity parameters of tolerance and variance inflation factor (VIF) were outside the critical range according to current guidelines (Kutner, Nachtsheim, & Neter, 2004).

Discussion

In this study, a group of paramedics was compared with individuals who did not work in healthcare in terms of self-reported stress, coping and personality factors, as well as psychophysiological reactivity. Furthermore, in the paramedic group associations of self-reported stress and bodily symptoms with coping strategies and personality traits were assessed. Paramedics had lower scores on the Worries, Tension and Joy subscales as well as on the sum score of the PSQ than controls, suggesting a lower stress burden. The comparison of the PSQ scores with a healthy norm sample (Fliege et al., 2005) indicated that the values of our control group were similar to the norm values. In contrast, the sum score of the paramedic group were approximately one SD below the norm value; and their scores on the Worries, Tension, Joy and Demands scales were also markedly lower than those of the norm sample.

Table 4. Results of regression analyses for the prediction of the Perceived Stress Questionnaire (PSQ) and the Von Zerssen Symptom Checklist (BL-R).

Perceived Stress Questionnaire (PSQ)	R^2	$F[1,29]$	*ß*	*t*	*p*	*Tolerance*	*VIF*
Stress Coping Style Questionnaire (SVF-78)							
Model 1	.14	4.48					
Negative strategies sum scale			.37	2.12	.04	1.00	1.00
Model 2	.28	5.25					
Negative strategies sum scale			.38	2.34	.03	1.00	1.00
Positive strategies sum scale			−.38	− 2.31	.03	1.00	1.00
Big Five Inventory (BFI-44)							
Model 1	.32	12.86					
Conscientiousness			−.56	−3.59	< .01	1.00	1.00
Saarbrueck Personality Questionnaire on Empathy (SPF)							
Empathic concern	.18	6.14	−.38	−2.17	.04	1.00	1.00
Sensation Seeking Scale (SSS-V)							
Adventure seeking	.19	6.45	.43	2.54	.02	1.00	1.00
Von Zerssen symptom checklist (BL-R)							
Stress Coping Style Questionnaire (SVF-78)							
Negative strategies sum scale	.22	8.04	.47	2.84	.01	1.00	1.00
Perceived Stress Questionnaire (PSQ)							
Worries	.32	13.39	.57	3.66	< .01	1.00	1.00
Big Five Inventory 44 (BFI-44)							
Model 1	.17	5.73					
Conscientiousness			−.41	−2.40	.02	1.00	1.00
Saarbrueck Personality Questionnaire on Empathy (SPF)							
Model 1	.28	10.67					
Fantasy			.53	3.27	< .01	1.00	1.00
Model 2	.39	8.47					
Fantasy			.47	3.03	< .01	0.97	1.03
Personal distress			.34	2.19	.04	0.97	1.03

Note: Only significant predictors are included in the table.

Paramedics also reported less somatic complaints on the BL-R. In addition, group differences were seen in psychophysiological variables. Paramedics exhibited reduced EDA reactions to emergency-related and non-specific aversive affective images and noises, and during mental arithmetic and mirror drawing tasks. Moreover, they demonstrated smaller heart rate deceleration during visual stimuli, as well as lower resting RSA. Our analysis pertaining to possible impacts of coping and personality traits on self-reported stress and health status showed positive associations of the PSQ sum score with the Negative strategies scale of the SVF-78 and the Adventure seeking scale of the SSS-V. The Conscientiousness scale of the BFI-44, the Positive strategies scale of the SVF-78 and the Empathetic concern scale of the SPF were inversely related with the PSQ score. The Worries scale of the PSQ, Negative strategies scale of the SVF-78 and Fantasy and Personal distress scales of the SPF positively predicted the BL-R score; and the Conscientiousness scale of the BFI-44 showed an inverse association with this parameter.

Regarding our psychophysiological assessments, the lower EDA responses during all stimulation conditions in paramedics imply diminished sympathetic nervous system activation (Dawson et al., 2007). Moreover, on the SAM scales paramedics indicated less arousal and unpleasant emotions during presentation of visual and acoustic stimuli. It is important to note that none of the corresponding ANOVA models revealed an interaction between the group and stimulation condition factors, which implies that the magnitudes of the group differences did not depend on the respective conditions. In particular, similar differences were observed for emergency service-related and non-specific visual and acoustic stimuli; moreover, in the visual paradigm, the group differences even involved responses to pleasant pictures. Considering this, the findings may at least partly reflect generally lower sympathetic reactivity and self-perceived arousal in paramedics, which are not restricted to particular kinds of challenging stimulation.

Heart rate deceleration during exposure to aversive images reflects a typical psychophysiological response to negative affective stimuli. This response is commonly seen in the context of orientation toward the stimulus, as well as during perceptual and emotional processing (Bradley & Lang, 2007b). The smaller amplitude of heart rate decreases in paramedics may therefore reflect a reduction in attentional-sensory processing and a diminished autonomic emotional response. In contrast, the ANOVAs for RSA during stimulus exposure did not reveal interactions between study group and experimental period, which would indicate different RSA responses in both study groups. Moreover, the lack of main effects of experimental period suggests that the acoustic and cognitive stimulation conditions did not elicit significant changes at all in either study group. Reductions in RSA, which are frequently observed during conditions of acute stress, indicate vagal withdrawal, which is an adaptive response in terms of cardiovascular adjustment to situational requirements (Berntson et al., 2016). Stimulation may therefore have been suboptimal, as it was apparently not sufficient to induce reliable vagal cardiac responses and therefore could not differentiate between study groups.

However, paramedics' exhibited higher RSA at rest than controls, which is indicative of enhanced cardiac parasympathetic tone (Berntson et al., 2016). Low RSA is a well-established risk marker for several physical and psychological disorders, as well as for general morbidity (Thayer & Lane, 2009). Moreover, studies of healthy individuals suggested that high resting RSA is related to improved emotion regulation and impulse control, more effective coping during stressful events and lower anxiety levels (Ramírez, Ortega, & Reyes del Paso, 2015). As such, high resting RSA is viewed as a beneficial psychophysiological state associated with overall improvement of health-status and positive coping resources (Thayer & Lane, 2009).

The notion of efficient coping in paramedics is also supported by the SVF-78 data, where paramedics exhibited lower scores on the Rumination and Resignation scales, and less use of negative coping strategies than the control group. It may be considered that paramedics' working conditions are particularly well-suited to promoting efficient coping strategies. These conditions are mostly characterized by alternating periods of routine work and intermittent periods of highly demanding operations and extreme stress levels; such conditions could foster the development of flexibility (Janka et al., 2015). Psychological flexibility refers to the ability to quickly adapt to the different demands of a situation, shift behavioral or mental resources in order to meet the requirements, and thus cope with negative experiences (e.g., Rozanski & Kubzansky, 2005). This characteristic can protect against the negative consequences of stress and, furthermore, support psychological health and wellbeing (e.g., Kashdan & Rottenberg, 2010). It has also been argued that, in terms of "stress inoculation" intermittent exposure to severe stressors, together with sufficiently long recovery phases, can promote psychophysiological toughness. Such a state is believed to be associated with emotional stability, improved immune system function and positive performance (Dienstbier, 1989; Janka et al., 2015). As an alternative explanation, increased stress resistance in paramedics may be due to professional selection. It may be hypothesized that individuals with sophisticated coping strategies may choose this occupation and, moreover, those who are less resilient are likely to change jobs in the course of their careers. By definition, the present data does not allow us to establish the degree to which adjustment and selection processes contribute to stress-resistance in paramedics; longitudinal studies would certainly be necessary for this purpose.

Regarding specific facets of positive and negative coping, our group comparison revealed the greatest effect size for the Rumination scale. This is noteworthy, as it has been demonstrated that high levels of this tendency are associated with increased perceived stress and burden along with mental and physical complaints (e.g., Haar, 2015). In a similar vein, our regression analyses in paramedics yielded associations of negative coping strategies with increased perceived stress and physical complaints, supporting the notion of unfavorable effects of maladaptive coping (Avraham et al., 2014). On the other hand, positive coping strategies were inversely associated with perceived stress, which underlines the positive implications of efficiently dealing with stress (Prati et al., 2011).

Our observations concerning personality traits may also be discussed in the context of coping with stress. Effect sizes for personality traits were overall lower than those for stress burden. However, paramedics exhibited higher values on the Conscientious scale of the BFI-44. It has been argued that being calm and deliberate, as well as working responsibly and organized and careful, facilitates adequate performance under conditions of elevated stress (Mirhaghi et al., 2016). This accords with our finding of inverse relationships of conscientiousness and self-reported stress with physical complaints, and previous reports of associations between high conscientiousness and improved resilience and better health status in emergency service personnel (e.g., Mirhaghi et al., 2016). Furthermore, paramedics scored lower on the Empathetic concern and Personal distress scales of the SPF than the control group. In this context, Regehr et al. (2008) reported that during operations, ambulance personnel tend to inhibit their feelings for patients, and thereby create an emotional distance; this may enhance their technical and cognitive ability to deal with the event. Grevin (1996) compared samples of paramedic students and experienced paramedics regarding coping and found that they did not differ in self-reported empathy, which may indicate that low empathy constitutes a relatively stable trait in paramedics. Our regression analysis showed an inverse association between the SPF Empathetic concern scale and perceived stress, which supports the notion that, in the context of emergency services, excessive empathy may be accompanied by increased stress (Grevin, 1996; Regehr et al., 2002). Moreover, the Fantasy and Personal distress scales of the SPF correlated positively with physical complaints. The interpretability of the unexpected finding pertaining to the Fantasy scale is certainly limited due to the content of this scale, which measures the tendency to identify oneself with characters from movies or fictional situations (Paulus, 2009). However, it has been well-established that high levels of distress can exacerbate physical complaints (Gayton & Lovell, 2012).

Corroborating previous studies (e.g., Klee & Renner, 2013), the presently investigated paramedics scored higher than controls on the Experience seeking dimension of the SSS-V. It is evident that individuals with low sensation seeking prefer professions with predictable challenges, exhibit a lower propensity for risk-taking and experience more fear of the unknown (Zuckerman, 2010). Compared to paramedics' work conditions, working as a clerk, teacher or mechanic is characterized by largely familiar tasks undertaken in a consistent setting; these professionals may feel less comfortable in unpredictable emergency situations. Surprisingly, the Adventure seeking scale of the SPF correlated positively with self-reported stress. This finding is difficult to interpret; it may be speculated that it relates to insufficient "thrills" experienced during downtime between operations, which may lead to dissatisfaction and distress in paramedics with a pronounced tendency towards adventure seeking (Jensen, 2005).

Limitations

A relevant limitation of the study design pertains to the heterogeneous composition of the control group, where extreme values on some variables in a specific professional subgroup may have led to distortion of results. For example, employees in social services may experience elevated levels of occupational stress due to enduring psychosocial demands at their workplace, which may have increased the indices of stress burden in the control group (Johnson et al., 2005). It also has to be acknowledged that potential effects of behavioral third variables could not be fully controlled for. While the study groups did not differ in physical activity, or alcohol and nicotine consumption, the possible confounders of eating and sleep behavior were not assessed. The focus on autonomic nervous system parameters as bodily indices of stress and emotion imposes another restriction on the generalizability of the findings. The additional use of endocrine measures, for example salivary cortisol, may have provided a more comprehensive picture on physiological responses (Nicolson, 2008). Moreover, the resting period of 1 min between the two cognitive tasks was relatively short. It is therefore possible that participants had not fully recovered before starting the second task; as such, carry-over effects cannot be excluded. With respect to the self-report assessments, the low reliabilities of the Boredom susceptibility and Experience seeking subscales of the SSS-V have to be taken into account. Finally, the relatively small sample size may be another restriction, particularly concerning the regression analyses conducted exclusively in the paramedic group.

Conclusion

In summary, this study revealed evidence of lower self-experienced stress burden, less somatic complaints, increased parasympathetic tone and reduced autonomic reactivity to aversive affective stimuli and cognitive challenge in paramedics vs. professionals from other disciplines. Together with the observation a reduced propensity towards using negative coping strategies, these findings may indicate marked stress-resistance in this group. Lower levels of empathy, as well as a greater tendency towards conscientiousness, can also be regarded as favorable with respect to the professional requirements of emergency services workers. This accords with our findings that the use of adaptive coping strategies, as well as high conscientiousness and limited empathy, were associated with lower levels of perceived stress and improved physical health in paramedics. Various experimental studies have indicated that the job performance of paramedics and health professionals strongly depends on their current stress level (e.g., LeBlanc, 2009). As such, in addition to health benefits, stress tolerance and adequate coping skills may also contribute to the prevention of stress-related performance decline during situations in which health, and even lives, are at stake.

Disclosure statement

No potential conflict of interest was reported by the authors.

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